Bridging the Gap between the Short and the Long Run in Macroeconomics.
Outline of the GSMS-SS Model of Economic Growth and the Business Cycle

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Abstract

The GSMS-SS model is a synthesis between the Solow-Swan (SS) growth model and the goods side/money side (GSMS) model. The GSMS-SS model shows why credit-driven economic expansions are unsustainable and how such booms revert into busts.

Key Words:
Economic growth, business cycle, quantity theory of money, equation of exchange, Solow-Swan, GSMS, GSMS-SS model, boom and bust cycle

JEL-Classification: E 32, E 44, E 52, 04

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1 Introduction

It is more than a nuisance that textbooks teach two kinds of macroeconomics, one for the short run and another one for the long run. For the short run, the ISLM and AS/AD models serve as standard approaches, while for the long run it is typically the Solow-Swan growth model, which is at the syllabus. Still, these types of models are incompatible with each other. Not only that: the ISLM and AS/AD models themselves are flawed (Colander 1995). These models make no clear distinction between the short and the long run and between nominal and real values. The lack to distinguish between the money side and the goods side of the economy leads to misperceptions such as that production would move automatically with aggregate demand or that central bank interest rate policy could calibrate investment.

The need is widely felt to come up with a more consistent framework that is solid enough to serve as workhorse for the classroom, yet also allows refinements and empirical investigations (Romer 2000). The goods side/money (GSMS) model provides such a tool for macroeconomic analysis (Mueller 2014). This model unites the quantity theory of money with the neoclassical growth model and reformulates natural output as that product which is in line with the steady state of the economic growth model. Linked to the Solow-Swan economic growth model, the emerging GSMS-SS model provides a tool of macroeconomic analysis as it demonstrates under which conditions economic expansions are sustainable or not.

2 A new synthesis

The basic version of the equation of exchange

$$Mx\ V_T = Tx\ P$$

says that all monetary transactions (T) in an economy are carried out with a definite amount of means of payment as money (M) that serve to realize the transaction at specific prices as it circulates (V) in the economy. Adding up all the monetary value of all transactions and dividing it by the number of transactions renders the average price (P).

$$\sum_i (p_i\ x\ p^T)\ x\ q$$

By counting the net value of contribution to the final product only, the equation of exchange says that the money stock in circulation (MV) is equal to the real product (Q) multiplied by the average price of the transactions (P) and as such represents nominal income (Y). The basic Fisher version (Fisher 1911) of the equation of exchange links money (*M*) and its velocity (*V*) to the product (*Q*) and the price level (*P*).

$$M\ x\ V = Q\ x\ P$$

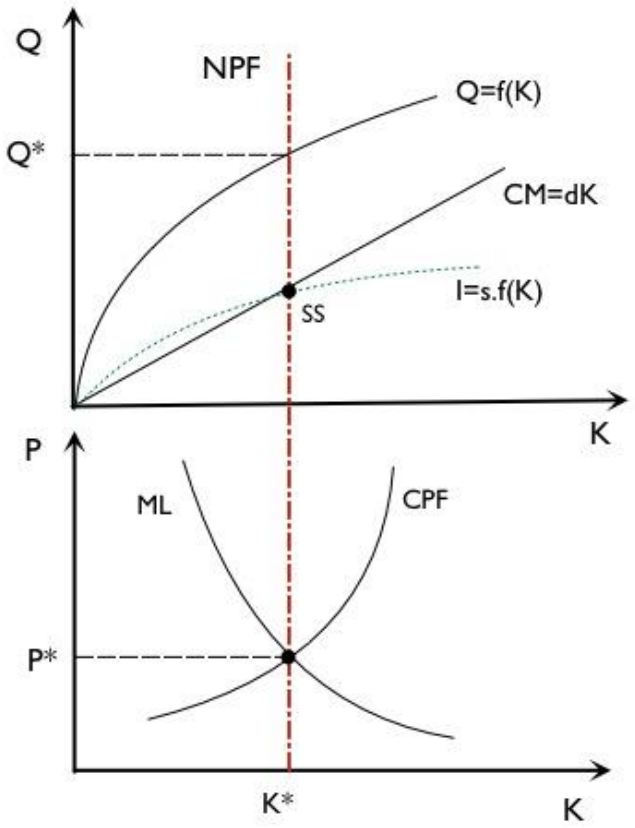
Bringing all monetary variables to the left side of the equation isolates the money side, leaves production on the right side of the equation as the goods side with output as a function of capital (given no population growth and no technological progress).

$$\frac{MV}{P} = Q = f(K)$$

For the goods side, the model makes the distinction between a natural (Q_n) and a cyclical (Q_c) output. The natural production frontier (*NPF*) represents that amount of production, which corresponds to the steady state in the economic growth model. The upper part of the graph (figure 1) represents a modified Solow-Swan (SS) model (Foltyn 2014) with capital as the variable factor of production. At the lower part of the graph, the natural production frontier (*NPF*) represents the regular or normal output at the steady

state of capital accumulation, which corresponds to the output at which the price level remains unchanged.

Figure 1
GSMS-SS steady state equilbirum



In the lower part of the graph, the cyclical production frontier (*CPF*) forms the link between the goods side and the money side. While the natural production frontier (*NPF*) represents the regular or normal output level, the cyclical production frontier (*CPF*) relates current output to the norm set by the natural output and the steady state. The more current production exceeds its natural level, the more scarcity increases and opportunity costs will rise. In monetary terms, the prices for the factors of production will augment. The cyclical production frontier determines the price level as a positive function of capacity utilization. The curve is elastic below natural output and becomes more inelastic when output exceeds the natural production frontier. Although the curve has a

shape and position similar to the Phillips curve (Gordon 2013), the concept of cyclical production frontier is analytically essentially different from the empirical Phillips curve.

The upper part of the graph (Figure 1) represents the standard economic growth model under the condition of a constant labor force and no technological progress. The steady state is determined when capital maintenance costs (*CM*) are equal to necessary investment (*I*), which are equal to savings (*S*) as a fraction (*s*) of income (*Y*) with output (*Q*) as a function of capital (*K*).

The analytics of the lower part of the graph come directly from the equation of exchange with

$$M = MB\ x\ m_b$$

$$Q = f(K)$$

$$MxV = ML = \ QxP = Y = C + I \ldots = Q_C x P_C + \ Q_I x\ P_I \ldots = AD$$

Here, macroeconomic liquidity (*ML*) represents money (*M*) in circulation (*V*) as it serves to pay for nominal output (*Y*), which as such represents aggregate demand (*AD*) in terms of expenditures composed of real product (Q_c, Q_I, ...) and their respective price level (P_c, P_I, …). This way, the model is not only a synthesis between the neoclassical growth model and the equation of exchange, but also makes the fundamental theorems of monetarism and Keynesianism explicit. Opening the black boxes of C, I, G, etc. makes it evident that the Keynesian aggregate demand models does not succinctly differentiate between real and monetary variables. Different from the GSMS approach, models of aggregate expenditure ignore that additional expenditure will only partially raise output or not at all because the price level can partially or fully absorb new money. Keynesian demand side policies target a certain output (Q*) that should be obtained by more deficit spending which mean an increase of the money stock (M). In terms of the GSMS model the basic Keynesian equation thus is:

$$Q^* = \frac{MV}{P}$$

In this form, it becomes obvious that demand side policies in order to work requires a constant price level. If this is not the case, additional spending could merely raise the price level (P) and leave output (Q) unaffected. Likewise, the set of equations shows that the monetarist thesis (de Long 2000) of a direct link between money (*M*) and

the price level (*P*) depends not only on the velocity of circulation (*V*), but also on the banking multiplier (m_b) and as such on the current and expected conditions in the financial markets.

The money side represents money in circulation of the equation of exchange (*M x V*) and as such constitutes "macroeconomic liquidity" (*ML*). Seen this way, it becomes clear that the concept of "nominal GDP targeting" (Thornton 2013) would focus on a steady increase of macroeconomic liquidity. As such, the concept of nominal national income targeting shows up as extended monetarism, with money augmented by its velocity as monetary policy target. Nominal gross domestic product targeting amounts to targeting macroeconomic liquidity (ML) as defined above.

$$NGDP = Y = QxP = MxV = ML$$

Different from the ISLM-AS model, the GSMS-SS model makes a strict distinction between the goods side and the money side. Spending in terms of national income (*Y*) is composed of the product between the price level (*P*) and output (*Q*). As such, nominal income (*Y*) is equal to macroeconomic liquidity *(ML*).

Moves on the ML-curve downwards to right indicate a rising purchasing power of money of a fixed macroeconomic liquidity. Shifts to the right of ML-curve signify an increase of macroeconomic liquidity neither as result of a rise in the money stock (*M*) or its velocity of circulation (*V*).

3 GSMS-SS model of economic growth

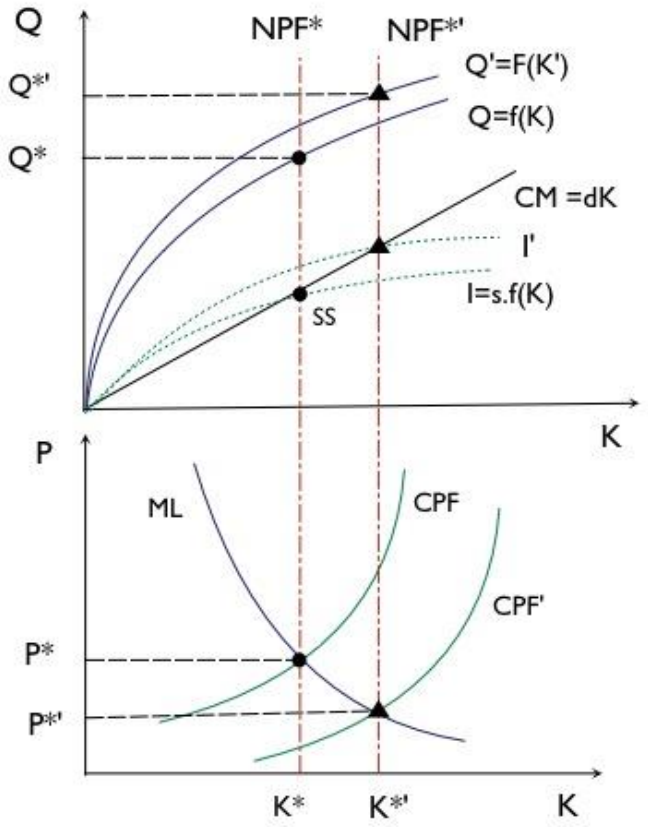
The GSMS-SS model helps to distinguish three types of economic growth. Firstly, there is economic growth as an enlargement or improvement of the factors of production – a shift of the natural production frontier (*NPF*) to the right. Secondly, economic activity may be due to a rise in the degree of use of the existent factors of production – a move along the cyclical production frontier (*CPF*). Thirdly, there is economic expansion that employs more capital yet will not last because current savings are insufficient of providing the funds that were necessary for maintaining the enlarged capital structure.

Sustained economic growth requires technological progress once the economy has reached steady state and can no longer grow merely based on capital accumulation. In the model (figure 2), technological progress lifts the curve of the production function and with it the savings/investment curve shifts upward, too. Higher productivity of capital due to technological progress allows the maintenance of the extended capital structure due to higher savings.

For the GSMS-SS model, technological progress happens at the level of the firm. For a company, technological progress is equal to higher productivity, and, *ceteris paribus*, is the way to increase profit. Rising productivity secures profits in the face of rising labor and capital costs and may compensate for lower prices. A competitive environment for business in all aspects drives companies out of necessity to procure innovation.

Figure 2

GSMS-SS growth equilibrium



The natural way of economic growth at constant macroeconomic liquidity (*ML*) would happen as a downward move of the cyclical production frontier (*CPF*) combined with a shift to the right of the natural production frontier (*NPF*). The new equilibrium would show up as higher output at a lower price level. Technological progress lifts the production function (*Q*) in the upper part of the graph (figure 2). Steady state (*SS*) moves to the right in accordance with the natural production frontier (*NPF*). Higher productivity leads to rising a rising income with savings large enough to fund the extended capital structure's (K*') maintenance requirements (*CM*).

When monetary authorities focus on the price level, they are inclined to transform natural economic growth into an unsustainable boom. In this case, the bust will happen as malign deflation and the economy faces deflationary contraction when the boom turns into bust. Different from this case, natural economic growth comes with benign deflation. While deflationary contraction happens abruptly, natural economic growth takes place at a moderate pace and economic actors will have time to adjust their expectation to a deflation that happens slowly over time.

4 GSMS-SS model of the business cycle

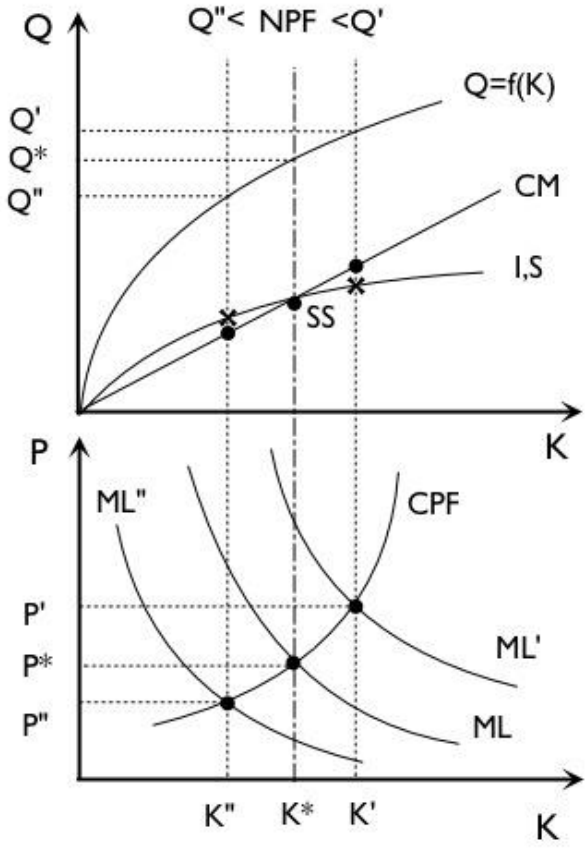
A monetary expansion that increases macroeconomic liquidity moves the economy beyond its natural production frontier and the steady state in the absence of higher savings when time preferences have not changed. While the monetary interest rate falls and investment rises, authentic savings are the same as before. There is more liquidity in the economy and the lower interest rate stimulates the extension of the capital structure while authentic savings have not increased. This kind of capital accumulation due to the expansion of liquidity faces the impediment of a lack of sufficient authentic savings that could fund the higher capital maintenance costs of the enlarged capital structure. Current output moves beyond the natural production frontier, and as production factors get scarcer, the price level will rise. At the same time, the economy moves beyond its steady state into a constellation where capital maintenance exceeds authentic savings.

A lower nominal interest rate will only temporarily reduce "capital costs". When the Fisher effect sets in (Mishkin 1991), the nominal interest rate rises to the level, which will compensate for the expected inflation rate and the nominal rate will rise again putting an end to the temporary profit boost. In the GSMS model, the growth rate of the natural

product (g_{Q_n}) depends on the increase of the degree of capital extension or the growth of roundaboutness of the economy's capital structure, while the growth of cyclical production (g_{Q_c}) relates to monetary factors given by the increase of macroeconomic liquidity (g_{ML}).

In terms of a sequential analysis, the stages of the business cycle begin with an upward shift of the ML-curve as consequence of a higher aggregate demand as the result of credit expansion (figure 3).

Figure 3
GSMS-SS model of the business cycle



Expansionary policy measures will pull the economy to an output level that exceeds the economy's steady state (SS) and natural production frontier (NPF/K*). When current output exceeds the natural production frontier, the economy moves into a position of insufficient funds to maintain the extended capital structure (K' > K*) with the consequence that capital erosion will set in and the economy is forced to move back towards a lower level of economic activity (figure 3).

The economy expands beyond the natural output level (Q' > Qn) along the cyclical production towards a higher price level. With labor, technological progress and the savings rate unchanged, funds are insufficient to maintain the extended capital structure. The monetary-induced economic expansion has increased output and the capital structure without the necessary complementary expansion in terms of savings and technological progress. As can be seen in the upper part of the graph (figure 3), the requirement of capital maintenance is above investment at point Q'/K' and consequently this kind of economic expansion will fail. With cost of capital maintenance above savings, the economy will shrink and the economic expansion process goes into reverse.

The economic contraction in the bust phase does not go merely back to the inception point, but the retrenchment will go further beyond the earlier equilibrium point because the failed expansion has come with bad investments. In the contraction phase, these malinvestments show up as debt overhang from projects that have become unviable. This means that the economic contraction (move to K''/Q'') will take place together with monetary deflation (downward shift of the ML-curve to ML''). Economic contraction entails that part of the accumulated capital becomes less valuable or worthless. In the contraction phase, the economy sheds unsustainable capital and shrinks to the point where savings will exceed the funding requirement for capital maintenance from which an automatic recovery can take place.

4 Macroeconomic configurations and policy concepts

Using the symbol g to denote variations in terms of growth rates, the equation of exchange becomes

$$g_M + g_V = g_Q + \pi$$

Using the term macroeconomic liquidity (*ML*) for money multiplied by its velocity, the equation becomes

$$\pi = g_{ML} - g_Q$$

In this reduced form, price changes (π) are related the difference between growth of macroeconomic liquidity (g_{ML}) and the rate of real economic growth (g_{ML} - g_Q). When applying the determinants elaborated above, the equation for price inflation becomes:

$$\pi = (g_{MB} + g_{m_b} + g_v) - (g_{Q_n} + g_{Q_c})$$

The condition for a zero price inflation rate *(π=0)* thus is

$$(g_{MB} + g_{m_b} + g_v) = (g_{Q_n} + g_{Q_c})$$

The rate of unemployment moves opposite to economic expansion, i.e. to cyclical growth, while natural economic growth (shift of the NPF-curve to the right) comes with steady employment or an employment rate that remains at its natural level (u_n). Therefore, the current unemployment rate (u_t) is a function of cyclical economic activity (g_{Q_c}), while the natural unemployment rate (u_n) coincides with the natural production frontier (*NPF*). Finally, nominal national income (*Y*) is the product of real production and the price level, or, specified by the model, its growth rate (g_Y) is:

$$g_Y = g_Q + \pi = g_{Q_n} + g_{Q_C} + \pi$$

These equations provide the tools to compose a table of macroeconomic constellations composed of the variables that show up in the set of the basic equations of the GSMS model (for a detailed exposition see Mueller 2014).

These macroeconomic constellations, which show up as shifts of the natural (*NPF*) and cyclical (*CPF*) production frontiers along with the curve for macroeconomic liquidity (*ML*), have at their basis potential and actual changes of the variables as determined in the extended dynamic equation of exchange.

In the equation

$$\pi = (g_{MB} + g_{m_b} + g_v) - (g_{Q_n} + g_{Q_c})$$

the aggregate change of the first expression in brackets ($g_{MB} + g_{m_b} + g_v$) determines the shift of the ML-curve, while the second expression in brackets determines the move of the natural (g_{Q_n}) and of the cyclical (g_{Qc}) production frontier.

Changes of the price level (π) and of output (g_Q) are the result of the move of variables such as the monetary base (*MB*), the banking multiplier (m_b) and velocity of circulation (*V*) in relation to moves of natural (Q_n) and cyclical (Q_c) output. The observation of these variables forms the basis to identify specific macroeconomic constellations by shifts of the curves macroeconomic liquidity (ML) and the cyclical (*CPF*) and natural production frontier (*NPF*).

Inflation targeting (π^*) and economic growth (g^*_Q) targeting show up in the GS/MS approach in the same set of equations.

$$g_Y^* = g_Q + \pi = g_{Q_n} + g_{Q_C} + \pi = g_{ML}$$

$$\pi^* = (g_{MB} + g_{m_b} + g_v) - (g_{Q_n} + g_{Q_c)} = g_{ML} - g_Q$$

$$g_Q^* = (g_{Q_n} + g_{Q_c)} = (g_{MB} + g_{m_b} + g_v) - \pi = g_{ML} - \pi$$

The equation for nominal national income targeting brings to light that this policy concept is monetarism with the inclusion of velocity. In terms of the GSMS model, gdp-targeting boils down to steering macroeconomic liquidity (*ML*). Practically, this policy concept would mean to compensate fluctuations of velocity (*V*) through variations of the monetary stock (*M*).

$$Y^* = MV = ML$$

$$g_Y^* = g_{ML}$$

Nominal national income targeting wants to compensate fluctuations in the natural and cyclical production frontier through monetary measures. The aim is to expand nominal gross domestic product at a specified rate based on the long-term composition of the growth rate of nominal income in its composition of real output growth (g_Q) and the inflation rate (π).

Inflation targeting (π^*), in contrast, uses the monetary variables only in order to compensate for expansion and contraction of the goods side.

$$P = \frac{MV}{Q}$$

$$\pi^* = g_{ML} - g_Q$$

Targeting real economic growth (g_Q^*), however, represents Keynesian-type monetary and fiscal policy with its claim that more spending would lift output.

$$Q^* = \frac{MV}{P}$$

$$g_Q^* = g_{ML} - \pi$$

Represented this way, it becomes clear that the demand-management approach fails to take into account that deficit spending (expansion of MV) need not raise output (*Q*) in any way, because it may just as well increase the price level (*P*) with zero effect on output. Opening up the black box of spending only a little more, reveals the pitfalls of demand-side stimulus policies.

$$Q^* = Q_C + Q_I + Q_G \ldots = \frac{MV}{P_C + P_I + P_G} \ldots$$

Stimulus policies confront not only uncertainty as to whether they mainly affect production (*Q*) or pries (*P*), but it is also ex ante uncertain which components of aggregate demand will receive the impact.

In terms of policy concepts, inflation targeting (π*) shows up in GSMS model as the extension of the monetarist concept of the control of monetary aggregates ($g_M = g_{MB} + g_{m_b}$) by its velocity of circulation (g_v);

$$\pi^* = g_M + g_V - g_Q = g_{ML} - g_Q$$

While the formulation of inflation targeting by the Taylor rule (Koenig 2012), defines the current output gap in terms of potential production, and thus in a certain way includes the distinction between the natural and the cyclical production frontier, it fails to account for beneficial deflation as the result of productivity gains. Likewise, nominal income targeting calls for a growth rate of nominal gross national product, while in fact

higher productivity should result in lower prices in combination with a higher output, which would mean that the size of nominal GDP (as $Y = Q\ X\ P$) would remain constant. When there will be strong economic progress, both policy concepts tend to move the economy beyond its natural production frontier and may instigate a boom-bust cycle.

Another problem of these policy concept results from expectations. For example, when uncertainties about the business climate (what Keynes called "long-term expectations") increase, the drive for roundaboutness will diminish and the natural production frontier will not expand. In such a case, expansive monetary policy in the form of the increase of the monetary base will produce price inflation (π), when the banking multiplier and velocity remain unchanged or do rise. When, however, current conditions and expectations will reduce the banking multiplier and diminish velocity in circulation, the expansion of the monetary base will move neither the price level nor the cyclical and natural output. Monetary policy may build-up uncontrollable inflationary potential in both of these cases due to an excessive growth of bank reserves and thus lays the groundwork for the next boom-bust cycle.

6 Conclusion

Conventional macroeconomic suffers from a rift between the short and the long run. Students learn two different kinds of macroeconomics with the ISLM and AS/AD model on the one hand and the neoclassical economic growth model on the other hand. The goods side/money (GSMS) model avoids these confusions. This model establishes a strict difference between output and money (the goods side and the money side). The GSMS-SS model relates the natural production frontier to steady state of the neoclassical growth model, while the cyclical production frontier links current production to costs and prices. The goods side/money side approach allows the analysis of a broad range of macroeconomic constellations and provides a versatile tool to model the business cycle. In its GSMS-SS versions, the model determines under which conditions economic expansions are sustainable or not. The GSMS-SS model reveals the deficiencies of standard macroeconomic policy concepts such as inflation and nominal national income targeting and of demand side policies.

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